



Taking Testing to the Cloud



Executive Summary

Cloud computing is opening up new vistas of opportunity for testing. Testing has traditionally been viewed as a necessary evil because it required a huge, dedicated infrastructure and resources that were used sporadically. Further, business applications are growing in complexity, making it difficult for organizations to build and maintain in-house testing facilities that mimic real-time environments. In broad strokes, technological virtualization has met base-level operational and financial objectives by eliminating the need for intensive capital investments. However, given the requisite set-up costs, many pioneering companies have yet to achieve the operational flexibility and scalability required to deliver on initial ROI forecasts.

Cloud-based testing has the potential to offer a compelling combination of lower costs, pay-per-use and elimination of upfront capital expenditures (Cap-Ex). The benefits, however, extend beyond cost. The non-cost factors include utility-like, on-demand flexibility, freedom from holding assets, enhanced collaboration, greater levels of efficiency and, most importantly, reduced time-to-market for key business applications.

At the same time, cloud-based testing introduces a new set of challenges, such as data security and a lack of standards, especially in the public cloud model. Given its early stages, we advise CIOs and CTOs to proactively explore cloud-based testing's advantages, while remaining aware of the operational and technical challenges, before moving forward.

Testing and the Cloud

While many companies are approaching cloud computing with cautious optimism, testing appears to be one area where they are willing to be more adventurous. There are several factors that account for this openness toward testing in the cloud:

- **Testing is a periodic activity and requires new environments to be set up for each project.** Test labs in companies typically sit idle for longer periods, consuming capital, power and space. Approximately 50% to 70% of the technology infrastructure earmarked for testing is underutilized, according to both anecdotal and published reports.
- **Testing is considered an important but non-business-critical activity.** Moving testing to the cloud is seen as a safe bet because it doesn't include sensitive corporate data and has minimal impact on the organization's business-as-usual activities.
- **Applications are increasingly becoming dynamic, complex, distributed and component-based, creating a multiplicity of new challenges for testing teams.** For instance, mobile and Web applications must be tested for multiple operating systems and updates, multiple browser platforms and versions, different types of hardware and a large number of concurrent users to understand their performance in real-time. The conventional approach of manually creating in-house testing environments that fully mirror these complexities and multiplicities consumes huge capital and resources.

Cloud's on-demand provisioning addresses these issues with one click. Moreover, the effort and resources saved in the development and testing area can be redeployed for core business pursuits. Recent research from Fujitsu¹ (see Figure 1) suggests that testing and application development rank second (57%) as the most likely workload to be put into the cloud after Web sites (61%).

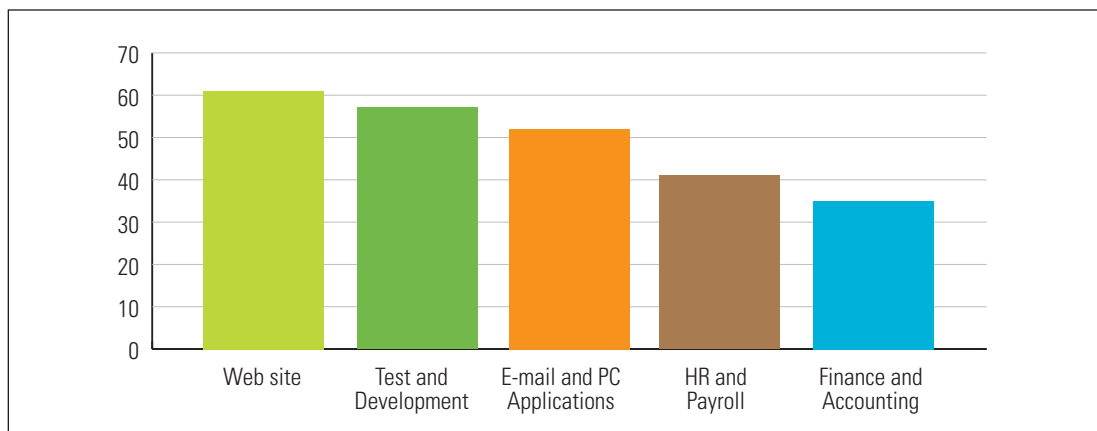
The Cost Factor

Cost reduction is the main factor influencing companies to embrace the cloud. An IDC² survey in 2009 found economic benefits as the key driver of cloud adoption (see Figure 2).

As the global economy strengthens, CIOs and CTOs continue to seek ways to contain costs and improve returns on IT investment. Testing in the cloud leverages the cloud computing infrastructure, reducing the unit cost of computing, while increasing testing effectiveness. A study of cloud-based testing service providers indicates that cost savings, including infrastructure, can vary from 40% to 70%.

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Top Applications in the Cloud



Source: Fujitsu, 2010
Figure 1

Small and medium-size businesses that cannot afford high Cap-Ex also find cloud-based testing an ideal approach. Fully managed cloud (public cloud) allows companies to shift to a flexible operating expenditure model (Op-Ex), since they no longer need to make upfront investments in infrastructure, tool licenses, configuration and maintenance of test environments, and they pay only for what they use. In the case of a private cloud, infrastructure can be decommissioned once the testing process is complete, which frees organizations from incurring expensive operational costs.

While the cloud’s ability to transform Cap-Ex to Op-Ex and reduce costs remains a work in progress, it is clear that the magnitude of cost benefits depends on various factors, such as the type of cloud chosen (private, public or hybrid), the configuration of the test environment and the type of tests conducted. Further, several additional factors such as the ability of testing teams to choose the right service provider, collaborate with the service provider and understand and utilize the cloud to minimize costs also play a key role.

Beyond Costs

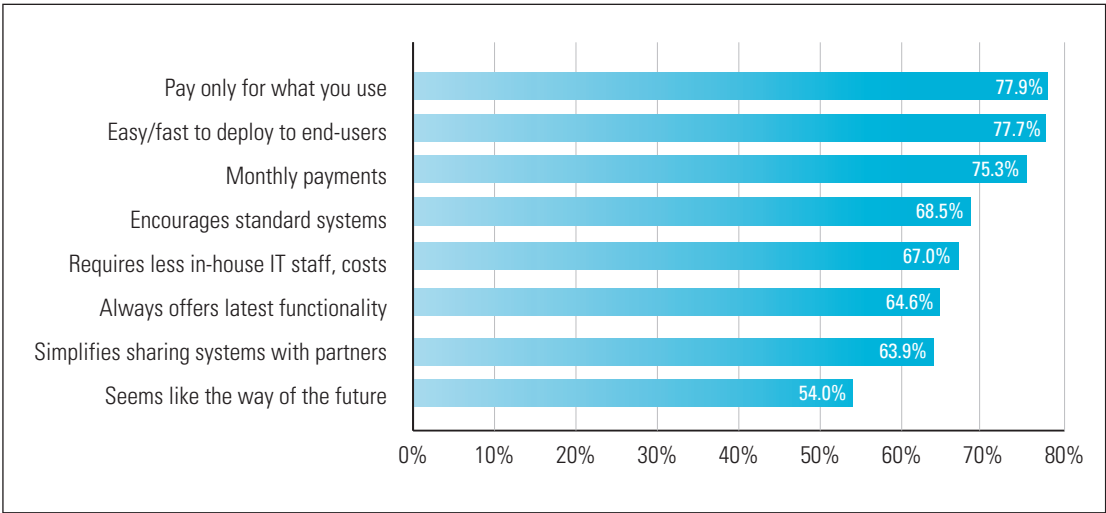
While lower cost remains a compelling lure, there is more to cloud-based testing than expense savings. Studies estimate that about 30% of defects are attributable to inaccurate configuration of test environments. Cloud-based testing service providers offer a standardized infrastructure and pre-configured software images that are capable of reducing such errors considerably. This standardization is achieved through the use of a service catalogue, which introduces the discipline of a “library” and a commitment to meeting service level agreements. All these actions result in the faster provisioning of test environments and the ability to meet operational objectives.

Time-to-market is often restricted by traditional test environments. That’s because creating on-premise test environments can be time-consuming and delay-prone. It can typically take weeks or months to set up a simple test environment for a single application, delaying its release. On-demand provisioning jumpstarts the process for forward-thinking companies, since testing resources required to meet time-to-market demands already exist in the cloud and can be provisioned instantaneously.

With cloud-based testing, organizations no longer need to worry about finding servers, procuring licenses for programs and testing tools and installing them. Service providers give testers access to scalable and ready-to-use virtual labs with a library of operating systems, test management and execution tools, middleware and storage necessary for creating a test environment that closely mirrors the real environment. Testers can run existing applications and virtual machines³ with minimal or no rewriting and utilize pools of virtualized infrastructure to scale up the test environment within minutes.

Cloud-based test environments give testing teams greater control to build and execute tests, analyze application performance and look for bottlenecks and stress areas even while tests are running. The cloud allows testers to scale from thousands to

Cloud Computing Benefits



Source: IDC
Figure 2

millions of concurrent users to assess the breaking points and capacity thresholds to combat highly unpredictable demand levels. This gives testers a clearer picture of possible runtime errors, which reduces production errors and better prepares companies for peak demand times (see sidebar, next page). All of these are vital to remaining nimble in today's increasingly competitive market.

Built-in cloud collaboration and management tools facilitate real-time collaboration with dispersed teams involved in the project via shared, cloud-based access to virtual machines. Once a tester logs in and executes a test, the results are available to developers, who can assess performance and fix anomalies over the cloud itself. This reduces back-and-forth communication between testers and developers regarding errors. Managers can monitor the overall progress of the project and drill down into specific tasks for review. This reduces cycle times and improves application deployment, while minimizing problems and providing users with an enhanced testing experience. For companies that are geographically dispersed and operating under tight deadlines, this allows for around-the-clock operations. Early adopters of cloud-based testing have found that their testing process is carried out five times faster on the cloud.⁴

Operational Challenges

Despite the bright upside, cloud-based testing has its limitations, too. Organizations must contend with a different set of challenges in their quest to reap cloud's benefits.

- **Lack of standards:** Presently, there are no universal/standard solutions to integrate public cloud resources with user companies' internal data center resources. Public cloud providers have their own architecture, operating models and pricing mechanisms and offer very little interoperability. This poses a big challenge for companies when they need to switch vendors.
- **Security in the public cloud:** Security in the public cloud is still a major concern, and encryption techniques currently available today are considered insufficient. Procedures are being developed to improve security and performance in the public cloud. For instance, service providers are developing virtual private clouds and client partitions. The main cause for concern is that the data may be stored in a remote location beyond an organization's legal and regulatory jurisdiction.
- **SLAs:** Terms and conditions of cloud service are sometimes hard to understand, misleading and biased toward the vendor.⁵ Such areas include clauses governing data integrity, data preservation, data location and transfer, according to a study by The Center for Commercial Law Studies at Queen Mary, University of London 2010. Companies would do well to be diligent and proactive in sorting through these issues with their vendors.
- **Infrastructure:** Some cloud providers offer only limited types of configurations, technology, servers and storage, networking and bandwidth, making it difficult to create real-time test environments.
- **Usage:** Improper usage of cloud-based test environments can increase costs. Even though some vendors offer pay-as-you-go cloud-based testing services, this approach can be expensive or out of sync with requirements, particularly if user estimates are too conservative or wildly overblown. Companies that apply pay-as-they-go approaches must first perfect their cost models or apply process-driven estimates rather than utilizing projections that are unsupported by data.
- **Planning:** Testing teams should rigorously plan their test environments, from utilization periods through disassembly. They should also be aware of the associated expenses, such as cost of encrypting data, before putting testing in a cloud environment, since these requirements will consume additional CPU and memory. It's important to monitor utilization of cloud resources to avoid over-usage and over-payment.
- **Performance:** As public clouds are shared by numerous users, there may be cases where a company might have to wait for the required bandwidth. There may also be cases where a service provider may suddenly announce disruption of service due to a maintenance window or network outage. Some of these issues can be resolved by working closely and proactively with the service provider.

While the cloud's ability to transform Cap-Ex to Op-Ex and reduce costs remains a work in progress, it is clear that the magnitude of cost benefits depends on various factors, such as the type of cloud chosen (private, public or hybrid), the configuration of the test environment and the type of tests conducted.

Do it the Right Way

Enterprises, especially large ones, are keen on building private clouds to use their internal test infrastructure and arm themselves with security and greater control over data. Private clouds facilitate customization and allow test equipment to be reused for different projects, thereby limiting the purchase of new software and hardware. According to Gartner, “organizations will also be faced with alternatives for the use of public cloud infrastructure, and these categories of tools are still on the upward slope of the Hype Cycle pre-peak of inflated expectations. We expect, however, that this category will see fairly rapid maturation and acceptance, reaching 50% adoption in enterprises by 2015.”⁷

On the other hand, small to medium sized businesses (SMBs) are expected to lead the adoption of public cloud for application testing, as setting up a private cloud is very expensive – in some cases, around ten times the cost of a public cloud (see Figure 3).

Moving testing to the cloud should be viewed as a strategic initiative rather than a tactical objective. To gain confidence, create a proof of concept. It is suggested that companies carry out pilots with specific objectives in mind before making the leap. Organizations that do not have sufficient testers can seek on-demand testing services, in which service providers take complete responsibility for testing in the cloud. Here are some questions to consider before moving forward:

1. What cultural change in the organization is required?
2. What process changes are required?
3. Who owns service management?
4. What changes in organizational/financial process alignment must be made to manage/provide for a new service?

A feasibility study is recommended to identify the scenarios in which moving testing to the cloud can benefit the organization. Testing managers should start by comparing the cost of in-house provisioning against the cost of using the cloud. It is important that organizations understand and analyze the range of benefits and proceed only if the strategy resolves a clear business need. The following steps can help companies more effectively test their applications in the cloud:

- **Build your understanding of the cloud:** Cloud is not the answer to all testing problems. Developers and testers with strong skills should collaborate and conduct unit, functional and integration tests throughout the lifecycle. It is important

Intuit's Experience

Financial software giant Intuit needed to test its online income tax service TurboTax, following internal predictions that a significant increase in the number of income tax returns would be filed online in 2009. Up until that time, the site was tested and certified to support only 4,000 concurrent users. Intuit was particularly focused on the two days preceding the tax deadline (April 14 and 15) when it expected a spike in demand, so it tested the application for at least 200% of expected peak on those days.

Intuit selected Soasta's CloudTest On-Demand service to simulate real-time traffic. Testing initially simulated 1,000 concurrent users and was gradually ramped up using the load generated from Amazon Elastic Compute Cloud EC2, ultimately simulating 300,000 concurrent users, while 25,000 customers were filing their returns online.

Soasta worked with Intuit for 33 days. The entire exercise helped the Intuit development team identify and fix defects quickly and better understand site performance. As a result, the TurboTax site met the peak performance load on the days when it mattered most.

Sources: Soasta, Inc. and Test Magazine⁶

to clearly understand your business needs, as well as the advantages and limitations of the cloud. To get more from your cloud investment, define the objectives of moving a particular testing project to the cloud.

Moving testing to the cloud should be viewed as a strategic initiative rather than a tactical objective.

selecting the required testing tools and applications, hardware and software, bandwidth, etc. and determine how long they will require them.

- **Select a service provider:** It is important for companies to thoroughly scrutinize service providers for security, quality, reliability and any discrepancies in the terms and conditions. Importantly, companies should look for conditions governing the exit or movement to another service provider. Seek service providers with considerable experience, that facilitate quick set-up and tear-down of test environments and provide a wide array of end-to-end services – ranging from physical infrastructure, testing tools and licenses, through provisioning.
- **Formulate your testing strategy:** The test strategy should clearly answer what is intended to be achieved by moving testing to the cloud, including cost savings, easy access to infrastructure, reduction in cycle times, etc. The strategy should define the type of tests to be performed in the cloud, the risks associated and the duration of the tests.
- **Plan your infrastructure:** Your test strategy also helps to define the infrastructure requirements necessary for building a test environment. Users should plan their test environments carefully by defining the infrastructure requirements necessary for building a test environment. Users should plan their test environments carefully by selecting the required testing tools and applications, hardware and software, bandwidth, etc. and determine how long they will require them.
- **Executing the test:** This is the critical phase where applications are tested according to the defined test strategy. Companies should plan and look for optimal utilization of the test infrastructure in order to realize cost benefits.
- **Monitor and analyze test results:** It is advised that test results be monitored in real-time to understand and react to capacity- or performance-related issues. Also, analyze cloud usage against chargeback costs to understand the financial performance of cloud services.

The Road Ahead

Testing has been the Achilles' heel of organizations, requiring massive upfront investments in an infrastructure that tends to be used sporadically. The cloud is well-suited to testing given its resource flexibility (from provisioning and deployment through decommissioning) and reduced security concerns, compared with the issues organizations face when considering placing production data and applications in the cloud.

We advise companies to start small and gain confidence with the benefits of cloud-based testing. Small victories build confidence over time, by speeding time to market, reducing costs (that multiply as cloud-based testing scales) and ensuring

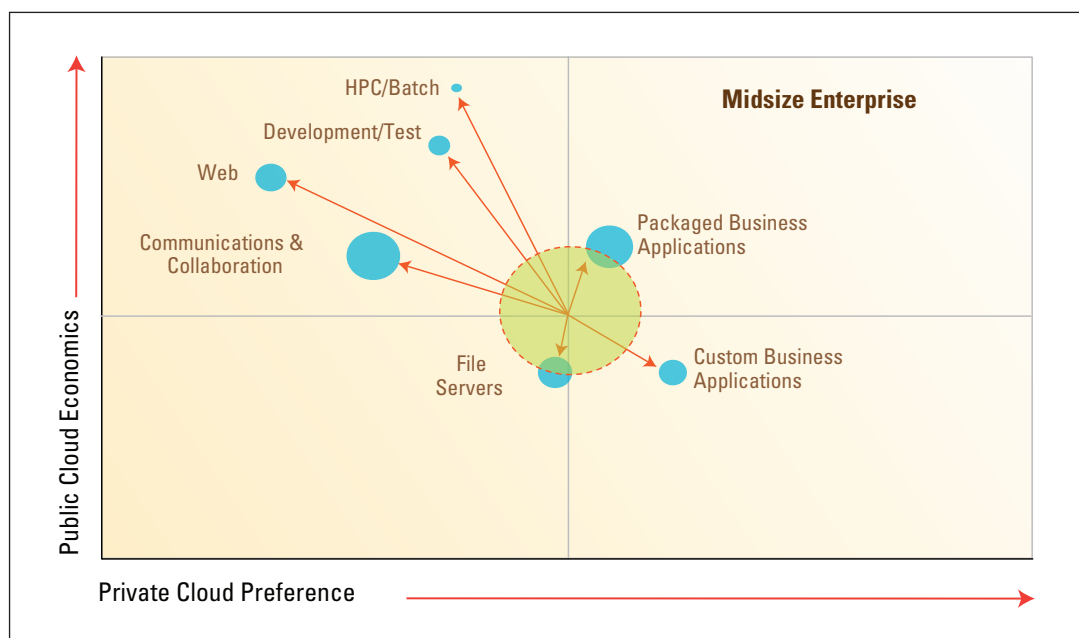
compliance with standards that demonstrate the service is both secured and reliable. Cost of operation and ownership will over time be reduced by companies that intelligently embrace pay-as-you-go or on-demand services. We suggest that companies pilot cloud-based testing as early as they feel comfortable to ensure they gain insights and benefits as these service offerings mature and become mainstream. Therefore, organizations seriously considering deploying testing as a service need an experienced partner that can ensure cost reductions are achieved or exceeded over time and that time-to-market of software products or services are similarly attained.

Organizations that do not have sufficient testers can seek on-demand testing services, in which service providers take complete responsibility for testing in the cloud.

It is our view that SMBs will harness public clouds, while large enterprises will leverage private clouds for their cloud-based testing services. But for companies small and large, the road to cloud-based

testing is paved with its own set of challenges. Companies confident enough to start early and push forward, however, will reap first-mover advantages that far outweigh the pioneering risks.

Segmenting the IT Portfolio



Source: Microsoft⁸

Figure 3

Footnotes

- ¹ "Confidence In Cloud Grows, Paving Way For New Levels Of Business Efficiency," Fujitsu, 2010.
- ² Frank Gens, Robert Mahowald, Richard L. Villars, David Bradshaw, Chris Morris, "Cloud Computing 2010: An IDC Update," International Data Corp., September 2009.
- ³ A virtual machine is a program or operating system that resides within a computer but is independent of the computer's operating system. An example is Java Virtual Machine, which is used to run Java applets and has no access to the computer's operating system.
- ⁴ Rob Berry, "QA Teams are Moving Testing to the Cloud, Conquering Internal Limitations," Search Software Quality, June 1, 2010, <http://www.allvoices.com/news/5966600-qa-teams-are-moving-testing-to-the-cloud-conquering-internal-limitations>
- ⁵ Tim Negris, "Data Danger Lurking in Public Cloud Contracts," *Cloud Computing Journal*, Nov. 30, 2010, <http://cloudcomputing.sys-con.com/node/1629419>
- ⁶ "Game-Changing Performance Testing," *Test Magazine*, January 2011, <http://www.testmagazine.co.uk/2011/01/game-changing-performance-testing/>
- ⁷ Thomas J. Bittman, "Test and Quality Management: The First Frontier for Private Cloud," Gartner, Inc., Sept. 3, 2010.
- ⁸ "The Economics of the Cloud," Microsoft, November 2010, <http://www.microsoft.com/presspass/presskits/cloud/docs/The-Economics-of-the-Cloud.pdf>

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